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ASPERGILLUS INFECTING MALACOSOMA AT HIGH TEMPERATURES

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In some experiments on the relation of temperature to the life-cycle of the apple tent-caterpillar (*Malacosoma americana* Fabr.), a serious difficulty presented itself in the mortality among the specimens at the higher temperatures due to the infection of the caterpillars with the fungus *Aspergillus flavescens* Eidam. With regard to the injurious nature of the fungi of the genus *Aspergillus*, DeBary¹ has the following to say: "A number of species of *Aspergillus*, all of which occur chiefly as saprophytes and in that mode of life reach their full development, in some cases even forming sporocarps, are able to migrate to the bodies of warm-blooded animals and live at their expense. Their vegetation causes or promotes a diseased state of the parts known to physicians as *mycosis*. *A. flavus*, *A. niger*, and *A. fumigatus*, *Eurodium repens*, and *Aspergillus glaucus* are characteristic promoters of the disease of the human ear which bears the name of *Otomycosis aspergillina*." In regard to the specific fungus with which we are dealing, he states that "Gaffky and others, Lichtheim especially, obtained characteristic phenomena of development, in this case phenomena of disease, when the gonidia of *Aspergillus fumigatus* and *A. flavescens* Eidam, two species distinguished by the high optimum of their vegetative temperature, over 37° C., were introduced by injection into the blood of animals, such as rabbits and dogs."

In the above mentioned experiments, the larvae were subjected continuously to a temperature of 35°-37° C., and were thus at the optimum developmental condition of *A. flavescens*. Although careful search was made in several nests of *Malacosoma americana*, only two specimens which showed any infection whatever from this fungus were secured, among many hundreds, and

¹ Comp. Morph. and Biology of the Fungi, Mycetoza and Bacteria, 369, 370. 1887.

these were in a nest which had been previously sprayed with a suspension of spores in sterile water. Thus the fungus cannot be classed as of economic importance since it is only at the higher temperatures that it does its damage.

These conditions suggested a series of experiments to try out the possibility of artificial infection at the normal and higher temperatures.

Six larvae from a perfectly normal nest together with a sufficient number of wild cherry leaves for food, were put into each of four sterile bottles, two of which were sprayed with a spore suspension and the other two kept as a check. The bottles were

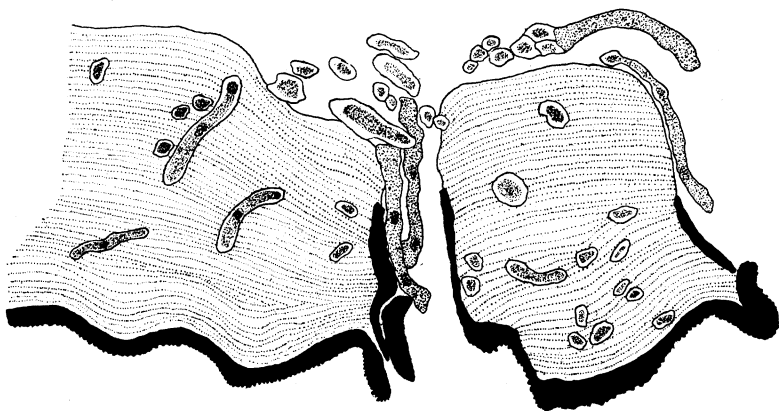


FIG. 1. Section through the cuticle of *Malacosoma americana* Fabr. showing the penetration of *Aspergillus flavescens* Eidam to the exterior through the region of a dermal pore, and the presence of the fungus in the inner layer of the chitin. $\times 400$.

plugged with sterile cotton and placed in the same compartment of an incubator maintained at a temperature of about 37° C. A similar experiment was conducted at the normal outdoor temperature (21° – 27° C.). At the end of three days all of the larvae in the sprayed bottle kept in the incubator were dead from infection with *Aspergillus flavescens*. The control specimens, at the incubator temperature, showed no signs of such infection. In the case of the experiment conducted at outdoor temperature, none of the larvae, either sprayed or unsprayed, showed any signs of such infection. A second series of these experiments was carried on with the same results as the first.

Daily observation of the larvae infected showed that the fungus first appeared at the posterior fourth of the body, and from this region progressed anteriorly. This seemed to indicate that infection takes place from the germination of spores taken into the digestive tract of the caterpillar along with its food. Favorable conditions for germination were found in the region of the hind intestine of the insect and the mycelia produced found their way through the intestinal wall into the body cavity and penetrated the chitinous covering in the region of the dermal pores to the exterior of the body. Sections of the larva substantiated this conclusion, and an examination of the accompanying figure will show the presence of mycelia and spores in the inner layer of the chitin covering the body cavity.

The entire body cavity was found to be filled with mycelia and multitudes of spores, accompanied by an almost complete disintegration of cellular structures. This cytolytic action, coupled with interference with the respiratory processes of the insect, affords sufficient cause for its death.

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